



Women farmers learn by doing.

Guinea-race Sorghum Hybrids

Bringing the benefits of hybrid technology to a staple crop in Africa



About ICRISAT



Science with a human face

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that does innovative agricultural research and capacity building for sustainable development with a wide array of partners across the globe. ICRISAT's mission is to help empower 644 million poor people to overcome hunger, poverty and a degraded environment in the dry tropics through better agriculture. ICRISAT belongs to the Alliance of Centers of the Consultative Group on International Agricultural Research (CGIAR).

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Introduction

In 1999, researchers from ICRISAT, the Malian Institut d'Economie Rural (IER), and the Institut National de l'Environnement et des Recherches Agricoles (INERA), Burkina Faso, were faced with the question, "How would you go about improving the productivity of sorghum in West Africa so as to improve food security and increase farmer's incomes, and do so by building on several thousand years of farmers' selection for adaptation and quality of grain?" Their answer, "lets work together to find ways of unlocking the genetic potential of the predominant sorghums of West Africa." These sorghums, an indigenous staple crop of West Africa belonging to the Guinea-race, combine excellent adaptation for these environments with high grain quality. Although having exceptional yield stability, their yield levels rarely exceed 2 tons/ha in farmer's fields.

Developing hybrids

One of the approaches researchers have pursued is the development of hybrids based on well-adapted Guinea-race parents. The benefits of hybrid vigor have long been reaped in India with widespread adoption of sorghum hybrids. The potential benefit of hybrid vigor under both favorable and drought prone conditions was shown experimentally by ICRISAT work in eastern and southern Africa. However, this progress has all been made with other sorghum races, races that lack specific adaptive characteristics required for successful



Guinea-race sorghum can withstand harsh environments.



Working together to unlock the genetic potential of existing landraces.

production in the main sorghum-growing belt of West Africa, which stretches from Senegal across to Burkina Faso.

The ICRISAT-IER-INERA team thus set out to create the first hybrid parents ever to be based on Guinea-race germplasm and possessing adaptation to the West African conditions. A search was begun to identify potential female parents (maintainer lines) through extensive test crossing of germplasm from three different sources: local varieties from Mali, inter-racial breeding lines from the IER program, and Guinea-race accessions of world-wide origin from the World Sorghum Collection in the ICRISAT genebank in India.

Many maintainer lines were identified, and through repeated backcrossing, "sterilized" to produce the first series of hybrid female parents. The first experimental hybrids were produced in 2004 on both inter-racial and Guinea-race based female parents. Regional testing of new sorghum hybrids is being conducted with collaboration of the National Research Programs in Mali (IER), Nigeria (IAR), Burkina Faso (INERA), Senegal (ISRA), and Ghana (SARI).

Reaping the benefits

The best hybrids significantly out-yielded all of the well-adapted check varieties in all of the research station trials. Despite the rains ending one month earlier than normal, average grain yield of the 22 highest yielding hybrids (top 20%) was nearly one ton higher (3.1 ton/ha) than the mean of three outstanding local varieties (2.3 ton/ha) in the ICRISAT-Mali trial. Even more important, the hybrid yield advantages in the first on-farm trial were identical to that observed in research station trials; an average advantage of 38% for the 20% highest yielding hybrids over a basket of three well-adapted local varieties.



A healthy stand of a Guinea-race sorghum.

These yield advantages are truly exciting as they provide what farmers are demanding – increased productivity while maintaining grain quality and retaining (or even enhancing) yield stability. And this is just the beginning. The Guinea-race of sorghum is the most diverse of sorghum races. We have just begun to explore the structure of diversity and patterns of heterosis (hybrid superiority over the parents). Initial results show that high heterosis can be obtained when parents from humid West Africa, East Africa, Southern Africa and even Asia are crossed onto a West-African tester. Accessions giving the highest heterosis in crosses with a West-African tester came from Cameroon, Zimbabwe and China.

Releasing the best

The first IER-ICRISAT jointly developed sorghum hybrid "Fadda" was released in Mali in 2008. Compared to the well adapted landrace variety Tieble, Fadda showed a 900 kg/ha yield superiority (35%) under good soil-fertility conditions and a 770 kg/ha (236%) superiority under low soil-fertility conditions. This hybrid, produced on an inter-racial female parent (02-SB-F5DT-12A) from IER and a Dwarf Guinea-race Population derivative (Lata) male parent, exemplifies the benefits of bringing together contrasting genetic materials from longer-term population breeding efforts. Large scale on-farm testing and demonstration of this and other hybrids is on-going in Mali and Nigeria.

Investing in the future

Even the best hybrids, however, will not bring benefits to producers and consumers without effective seed production. Training for effective hybrid seed production was conducted for NARS breeders from eight institutions in six

West African countries as a part of a hybrid breeding training course ICRISAT with IER also organized hybrid seed production field days for exposing emerging private seed companies, Faso Kaba and SOCEM, a farmer seed producer cooperative COPROSEM, the Professional Farmers' Organization (AOPP), and representatives of the National Seed Service and Foundation Seed Unit to hybrid seed production methods.

Conclusion

ICRISAT and partners have gained a rich experience through the development and release of the guinea-race sorghum hybrid, which ultimately benefits the farmers and consumers. IER is now empowered to initiate on-farm hybrid seed production directly with farmer seed producers, and simultaneously engage private seed company personnel to "learn by doing". The participating farmers already produce seed for an emerging seed company, Faso Kaba, which is keen to launch sale of hybrid sorghum seed nationwide in 2009. IER is enthusiastically pursuing sorghum hybrids as a way to meet farmers' and consumers' needs as sorghum changes from a subsistence crop to an increasingly important source of income.

The substantial financial and moral support from the Rockefeller Foundation, with which this work was initiated 9 years ago, and the USAID financed West and Central Africa Sorghum Research Network (WCASRN) support for expanding the hybrid development and testing work to five West African countries, is greatly appreciated.



Staff of national systems being trained for effective seed production.